Energy, Mines and Resources Canada
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CANMET
Canada Centre for Mineral and Energy Technology
Centre canadien de la technologie des minéraux et de l'énergie

PREVIEW OF CANMET'S MINING TECHNOLOGY DEVEL NT INDEX

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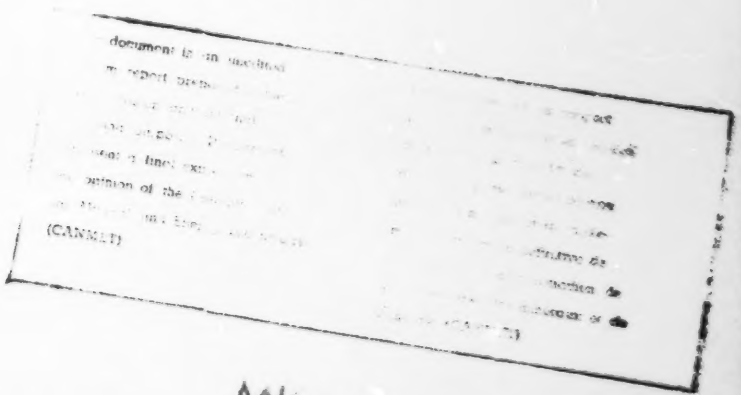

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PREVIEW OF CANMET'S MINING TECHNOLOGY DEVELOPMENT INDEX

SUMMARY

As recommended by the Mining Sub-committee of the National Advisory Committee on Mining and Metallurgical Research (NACMMR), CANMET's Mining Research Laboratories (MRL) propose to establish and maintain an "on-going" current technical awareness service by and for all relevant organizations associated with the Canadian Mining Industry. The proposed technology project data base will encompass activities dedicated to mining technology development, productivity improvement and basic research. The survey information to be assembled will consist of project titles pertaining to mining, with brief descriptions of the nature and scope of activities in question. The participation of all relevant organizations will be solicited. A majority response will be essential, in order to establish a viable service.

Personal contact by field visits will be supplemented by mail and telephone. Edited returns will be placed in computer storage. As each national survey is completed, results will be circulated to all participants, classified by contributors. On request, reported survey projects will be made available by other classifications, utilizing key words. It is envisaged that future surveys will be conducted at regular intervals, possibly annually, on an "on-going" basis.

This service was conceived because there is a limited interchange of information pertaining to mining technology improvements which are being developed in Canada. The national information network, then, should have the potential to provide valuable information to the industry on new or modified technologies, as well as on projects designed to improve productivity. The anticipated effect will be to assist in increasing mining efficiency and reducing operational costs. Analyses of survey results may be expected to be of assistance to both private and public sectors in determining subject areas which are receiving "overlapping" attention, as well as in identifying "gaps".

The NACMMR Mining Sub-Committee, recognizing that there was no national mechanism for exchanging information on mining research projects, recommended that CANMET should develop such a service on a top priority basis. Accordingly, in response to this need, CANMET has added the project as an activity of its Mining Research Laboratories. The first phase of this work involved contacting senior executives representing Canadian mine operating companies and other organizations. Their active participation was solicited and they were requested to designate working contacts. The next phase, involving the acquisition of information from designated contacts, is now in progress.

It is intended that a complete printout of results will be circulated to all participants after each survey and that the information contained in the data bank shall never be more than a few months out of date. In addition, the associated computer data base should be available to participants at all times, in order to accommodate supplementary requests for information. These activities have been assumed by CANMET.

The appendices included in this report depict the responses to date. Indications are that a viable technology information service will result.

APPENDIX A

ACTIVITIES OF PARTICIPATING ORGANIZATIONS: MINING TECHNOLOGY DEVELOPMENT INDEX

1984

ACTIVITIES MENTIONED: MINING TECHNOLOGY DEVELOPMENT INDEX, 1984

PARTICIPATING ORGANIZATIONS	TECHNOLOGY DEVELOPMENT ACTIVITIES
La Compagnie Minière Québec Cartier PORT CARTIER, Québec Raynald Fournier, Director Engineering and Research (418) 766-2321	Virtually all company R&D pertains to metallurgical operations; some projects include: (1) A large sintering study being conducted in Belgium and USA. (2) Elimination of discolouration in liquid mill effluents. (3) Computerized system to improve concentrate feed blending (developed at McMaster). (4) Means of relating drill hole cuttings from each ore block to ore reactions in the mill, to improve the predictability of concentrate grades (5) Improvement of recovery of iron fines now lost in tailings. (6) Development of an on-stream analyser for instantaneous reaction to changes in milling conditions. (7) Elimination of a moisture migration problem in concentrates.
Denison Mines Limited ELLIOT LAKE, Ontario Peter Townsend Chief Industrial Engineer (705) 848-9111 Ext. 272	Mining Technology Development projects include: (1) Program of large-scale underground testing of heap leaching. (2) Backfill mining program, involving testing of open and free drainage fill fences, filter media and various types of drainage pipes. (3) Testing of two drill jumbos which have been converted for up-hole drilling. (4) Continuing search and evaluation of low profile mining equipment.
Detour Lake Mine Campbell Red Lake Mines Limited TIMMINS, Ontario R. Mandell, Chief Mine Engineer (705) 268-3333	The major effort in technology development is the improvement of the output of mill equipment by changing feed characteristics rather than modifying the equipment. - Activities in mining technology development will be confirmed.
Falconbridge Limited FALCONBRIDGE, Ontario Martin Musson Superintendent Mines Engineering Services (705) 693-2761	Current technology development and R&D projects have been noted, based on visit discussions. Projects devoted to mining technology development include: (1) Currently overseeing a HDRK project to automate drill rod handling. (2) Test work underway to reduce the cement content of backfill and increase the slag content. (3) An on-going review of equipment strengths and weaknesses in progress.

ACTIVITIES MENTIONED: MINING TECHNOLOGY DEVELOPMENT INDEX, 1984

PARTICIPATING ORGANIZATIONS	TECHNOLOGY DEVELOPMENT ACTIVITIES
Falconbridge Limited (contd)	(4) Program in place to optimize big-hole blasting by monitoring vibration and by mine wide microseismic monitoring of ground movements. (5) Methods being studied to improve ore recovery from pillars between filled stopes. (6) Plans to develop automated down-the-hole drilling. (7) Plans to evaluate high pressure water drills being considered.
HDRK Mining Research Limited COPPER CLIFF, Ontario Milton E. Jowsey Director of Research (705) 682-0393	From summary notes recorded during a field visit, the principal thrusts of its projected mining R&D are noted. HDRK was created jointly by four mine operating companies to perform mining R&D projects which are unanimously approved. Its principal mining technology development projects are expected to pertain to: (1) Development of technologies, techniques and equipment for the cutting of hardrock, utilizing high pressure water jets with other relevant devices. (2) Studies to improve productivity in raise boring. (3) Possible future studies pertaining to continuous mining, including the use of ore sorters in conjunction with the continuous breakage of rock
Hudson Bay Mining and Smelting Co. Limited FLIN FLON, Manitoba L.R. Nilsen Vice-president and General Manager (204) 687-5396	Response received indicating that in mining the company concentrates on rock mechanics research; other relevant mining activities will be obtained subsequent to a site visit. -Metallurgical technology development includes: (1) Design of a continuous fluxing process. (2) Development of a mechanical stacker in the zinc plant. (3) Examination of a two-stage pressure leach.
INCO Limited COPPER CLIFF, Ontario C. Barsotti Manager of Mines Research (705) 682-5261	Mining technology development and R&D projects include the following: (1)" Evaluation of smooth wall blasting techniques." (2) "Development of a 'spray on' coating for ground support." (3) "Investigation of nickel slag as a binding agent for fills." (4) "Field testing of blasting charges." (5) "Evaluation of roller compacted concrete for underground roadway paving." (6) "Blast vibration monitoring."

ACTIVITIES MENTIONED: MINING TECHNOLOGY DEVELOPMENT INDEX, 1984

PARTICIPATING ORGANIZATIONS	TECHNOLOGY DEVELOPMENT ACTIVITIES
INCO Limited (cont'd)	(7) "Investigation of strengths of consolidated fills." (8) "High density fill." (9) "Surveying deviations in long large diameter (6½") drill holes." (10) "Blast simulation by computer model." (11) "Testing of 'double-decked' crater blasting." (12) "Evaluation of water emulsion explosives." (13) "Development of an ITH machine with component breakdown to a 24"x24" size." (14) "Development of a 'timberless' undercut and fill mining method." (15) "Investigation of grouts to consolidate in situ fill materials." (16) "Microseismic monitoring." (17) "Development of a 3-D numerical modelling system for rock mechanics." (18) "Investigation of iron ore blast furnace slag as a binding agent for fills."
INCO Limited THOMPSON, Manitoba G.J. Marshall Assistant Vice-president Mining (204) 677-5228	Full suport assured; results to be obtained subsequent to site visit.
Johns Manville Canada Inc. Asbestos Fibre Division ASBESTOS, Québec G. Bernard Coulombe Jeffrey Mine Manager (819) 879-5431	Considerable company R&D is devoted to milling problems, involving: (1) Evaluation of the economics of gas or electric drying as a replacement for bunker "C". (2) Development of automation and remote control equipment for possible use in the milling operation. Mining related projects include: (1) Continuing collaboration with Québec Hydro and General Electric to evolve a trolley-truck haulage operation. (2) Installation and evaluation of 20 feet stressed cable bolts in pre-sheared pit walls. (3) Analysis of automatic skip loading - not currently economic.

ACTIVITIES MENTIONED: MINING TECHNOLOGY DEVELOPMENT INDEX, 1984

PARTICIPATING ORGANIZATIONS	TECHNOLOGY DEVELOPMENT ACTIVITIES
Mines Accident Prevention Association Ontario (MAPAO) NORTH BAY, Ontario E.W. Isaac Executive Director (705) 472-4140	This organization dedicated to improving mining health and safety has submitted a summary of its principal activities pertaining to mining technology development. These include: (1) Maintenance of a ventilation advisory service to Ontario mines. (2) Introduction of a uniform accident investigation form for Ontario Mines in order to subject assembled data to computer analysis. (3) Development and circulation of a uniform rock-burst report form again designed to subject resulting data to computer analysis. (4) A mine lighting study to recommend types and spacing of lights for various underground situations.
The Mining Industry Research Organization of Canada (MIROC) TORONTO, Ontario R.D. Lord Research Director (416) 862-1417	This is an organization, created and supported by several major mine operating companies in Canada, designed to pursue cooperative mining research. An office visit has been made. Some of MIROC projects, on which information has been published, are noted as follows: (1) Preliminary investigation of ways to try to improve miners' personal working gear, pertaining to hearing, respiratory protection, various items of clothing and lighting equipment. (2) Development of a miner's air-flow helmet, featuring dust protection and incorporating a new lamp. (3) Development and field testing of a 12-volt mini halogen cap lamp. (4) Development of a miner's worksuit, with a comfortable water-resistant fabric. (5) Development of a lighter and more protective workboot than previously available. (6) Development of a system for monitoring mine ventilation. (7) Development, and ultimately field testing, of a new concept for underground radio communications. (8) Consideration of the development and testing of a new concept for air-powered space lighting underground.

ACTIVITIES MENTIONED: MINING TECHNOLOGY DEVELOPMENT INDEX, 1984

PARTICIPATING ORGANIZATIONS	TECHNOLOGY DEVELOPMENT ACTIVITIES
Noranda Research Centre Noranda Inc. POINTE CLAIRE, Québec Jacques Nantel, Head Mining Technology Division (514) 697-6640	Subsequent to a field visit, a complete list of Noranda operations contacts was received, as well as summary of principal mining technology development projects by staff at Noranda Research Centre. The latter includes: (1) Preparation of a proposal to develop a new mining method with one of the main objectives being to reduce or eliminate the cyclic elements of mining. (2) Study of the in situ consolidation of backfill by freezing, injections, etc., to reduce cement costs and the dilution of pillar ore. (3) Review of the use of ice as a temporary fill material while mining pillars. (4) Study of the in situ mining of copper oxide ore by leaching. (5) Preparation for field testing of an ultra sonic survey probe for determining the contours of inaccessable open stopes. (6) Development of a CAD system for mine design, utilizing personal computers rather than costly main frame equipment. (7) Consideration of the development of novel ground monitoring instrumentation to overcome deficiencies of existing instrumentation, such as awkwardness, non re-usability, expense and a low success ratio.
Potash Corporation of Saskatchewan Mining Limited SASKATOON, Saskatchewan W.E.G. Taylor Manager R&D Mining Department (306) 664-5530	Initial summary report received indicating relevant work in mining technology developments. Projects recorded are as follows: (1) Evaluation of communications systems, especially those with frequencies which pass through salt. (2) An evaluation study of a mining machine bit. (3) Backfill project investigating underground fill transport, fill placement, drop pipes and backfill compaction. (4) Field tests of a device for on-board monitoring K-40, for a projected machine mounted ore analyser. (5) Studies pertaining to the sonar guidance of mining machines. (6) "On-going" seismicity study encompassing surface and underground monitoring to detect mining induced earth movement.

ACTIVITIES MENTIONED: MINING TECHNOLOGY DEVELOPMENT INDEX, 1984

PARTICIPATING ORGANIZATIONS	TECHNOLOGY DEVELOPMENT ACTIVITIES
Qit-Fer et Titane Inc SOREL, Québec Dr. Alfonso E. Grau Manager of Research (415) 742-6671	80% of company R&D pertains to smelter and other metallurgical operations; major "on-going" project is the search for suitable smelter feedstocks.
Rio Algom Limited ELLIOT LAKE, Ontario S.N. Muppalaneni Superintendent Mining Services (705) 461-2528	Written report describing technology development projects has not yet been received. Interim notes have been compiled from visit discussions. It is understood that some of its mining technology development activities include: (1) Introduction of a safety system. (2) Installation of a new rail haulage system. (3) Study of microseismic ground monitoring. (4) Study of low-profile haulage equipment. (5) Development of computerized warehousing and maintenance systems.
Sherritt Gordon Mines Limited LYNN LAKE, Manitoba G.P. Holmes, Manager Milling and Development (204) 356-2201	Research is currently concentrated on mineral processing optimization. Site visit is planned to establish mining activities devoted to productivity improvement.
Sigma Mines (Québec) Limited VAL D'OR, Québec Marc-G. Tremblay General Superintendent (819) 825-4182	Virtually no R&D in mining according to report. Efforts now concentrated on project to improve refinery operation by reducing impurities poured into (gold) bricks.
Cominco Limited Sullivan Mine KIMBERLEY, British Columbia J.W. Reynolds, Superintendent Technical Development (Retired in Kimberley) (604) 427-5516	Summary written response received, indicating full future support pertaining to all company mining operations. For more details of relevant company projects, a site visit to Kimberley is planned. This initial submission reports the following mining technology development projects: (1) Experimental operational testing of 4½" up-hole drills. (2) Consideration of underground computer terminals for shift boss reporting. (3) Successful installation of an underground communications system based on leaky cable equipment.

ACTIVITIES MENTIONED: MINING TECHNOLOGY DEVELOPMENT INDEX, 1984

PARTICIPATING ORGANIZATIONS	TECHNOLOGY DEVELOPMENT ACTIVITIES
Cominco Limited (cont'd)	(4) Continuing research involving new explosives. (5) Continuing research into fire resistant hydraulic fluids. (6) Continuing research into the control of diesel emissions. (7) Studies of ways to stabilize permafrost. (8) Consideration of researching and developing a mining machine that would operate in hardrock headings dipping from +5° to +85°.
Mining Research Laboratories CANMET Energy, Mines and Resources Canada OTTAWA, Ontario G. Larocque Rock Mechanics Laboratory (613) 996-4570 Ext. 220	CANMET non-coal mining technology development projects include: (1) Development of a mining cost computer data base, cost models and mine evaluation procedures. (2) Development of technology and methods for the management of mine/mill waste to reduce environmental impact. (3) Participation in the preparation of national safety standards pertaining to equipment operation in underground mines, while conducting research in the fields of gas and dust explosions and fire resistance. (4) Evaluation of environmental contaminant and ventilation parameter sensors and systems for underground environmental assessments. (5) "On-going" development of technology related to the manufacture, storage, transportation and use of explosives. (6) Development of an optimal air quality index, in conjunction with field trials of diesel emmision reduction strategies. (7) Development and testing of radiation instrumentation for measurement and control of radiation. (8) Investigation of underground stability related to geological structure and gravitational forces and development of empirical, statistical and deterministic models to predict structural stability. (9) Investigation of underground stability related to high stresses and associated rock bursts and, using instrumentation, study of empirical and computer models, mining layouts and designs to minimize failures. (10) Development of new computer models for evaluating stabililty of underground openings and related structures.

ACTIVITIES MENTIONED: MINING TECHNOLOGY DEVELOPMENT INDEX, 1984

PARTICIPATING ORGANIZATIONS	TECHNOLOGY DEVELOPMENT ACTIVITIES
Mining Research Laboratories CANMET Energy, Mines and Resources Canada OTTAWA, Ontario (cont'd)	(11)Contract research for Canadian potash mining pertaining to ground control, environment and productivity. (12)Promotion of mining equipment developments for mine development, production and transportation, as well as assessment of the impact of such equipment on mine design, including associated automation, remote control or robotics. (13)Studies devoted to the development of techniques for reducing the noise levels of diamond drilling equipment. (14)Evaluation of the limitations and effectiveness of existing and proposed support systems for use in deep mining under high stress conditions. (15)Laboratory tests on rocks and other structural materials to provide material properties data for parallel field and model studies. (16)Measurement of the current levels of respirable dust in selected Canadian mines, as well as identification and assessment of dust control measures. (17)Quantification and documentation of the major sources of vibration in hardrock mines, combined with development of indicated instrumentation.
Centre de Recherches minérales Ministère de l'Energie et des Ressources SAINTE FOY, Québec Dr. Marc Denis Everell Directeur-Général and Louis G. Tanguay Chef du Service de Technologie Minière (418) 643-4504	This Centre was formed in 1982 to support current university research. Mining technology development projects include: (1) Phase 1 of an underground communications study, now being finalized, incorporates the evaluation of systems now available for underground usage, the evaluation of the suitability of such system components for use in an underground environment, the evaluation of underground communication needs, as well as the determination of costs. (2) Phase 2 of the underground communications study, now being formulated, is designed to determine the best system for particular underground needs (3) A study of energy economics, including the use of heat exchangers, as well as the cleaning and re-use of hydraulic and lubricating oil. (4) "On-going" rock mechanics/geotechnical study at the Belmoral Mine.

ACTIVITIES MENTIONED: MINING TECHNOLOGY DEVELOPMENT INDEX, 1984

PARTICIPATING ORGANIZATIONS	TECHNOLOGY DEVELOPMENT ACTIVITIES
Centre de Recherches minérales Ministère de l'Energie et des Ressources SAINTE FOY, Québec (cont'd)	(5) Long-term projects to increase expertise in rock mechanics. (6) Long-term projects to develop computer software for mine usage. (7) An "on-going" study projected to determine rock bolting needs at Les Mines Seleine Inc. (8) Provision of "on-going" technical services to the Québec mining industry on hoisting plant operations. (9) By means of research contracts, studies are being conducted encompassing a survey of mine needs for computing devices and software, mine ventilation simulation and optimization, as well as relationships between bonus, productivity, profitability and security.
Earth Sciences Sector Energy, Mines and Resources Canada OTTAWA, Ontario G.D. Pearce External Research Program (613) 995-3081	By means of research grants, EMR is contributing financial resources to the majority of universities in Canada to promote the development of mineral technology. However, virtually none of these R&D projects pertain directly to mining technology, with most dedicated to geological and metallurgical problems.
Natural Science and Engineering Council of Canada (NSERC) OTTAWA, Ontario G. McNabb, President (613) 993-4370	Selected proposals from Canadian research organizations and universities are supported by grants from NSERC. Again however, few which are approved pertain to mining technology development or R&D.
Université Laval Cité Universitaire QUEBEC, Québec Pierre Pedneau, Director Research Office Directeur du Bureau de la Recherche (418) 656-2572	Laval submitted a comprehensive printout of research projects to 1983, pertaining to mining and metallurgy. Those related to mining technology development include the following: (1) "Ventilation minière: impact des normes de sante au travail." (2) "Implementing a monitoring system for the ventilation network at Brunswick Mining and Smelting Corporation Limited." (3) "Evaluation quantitative informatisée de la ventilation minière." (4) "Dimensionnement des piliers de surface d'exploitations minières." (5) "Assistance à la planification d'exploitations souterraines à mines Gaspé." (6) "Dimensionnement des revêtements de beton des galeries souterraines."

ACTIVITIES MENTIONED: MINING TECHNOLOGY DEVELOPMENT INDEX, 1984

PARTICIPATING ORGANIZATIONS	TECHNOLOGY DEVELOPMENT ACTIVITIES
Université Laval Cité Universitaire QUEBEC, Québec (cont'd)	(7) "Etude du soutirage des blocs mineralisés aux niveaux 16 et 18 de la mine." (8) "Influence de la prime au rendement sur les accidents du travail dans les mines souterraines du Québec." (9) "Recherche en fluorescence." (10)"Granulometre continu à laser." (11)"Prevision de l'imminence de l'effondrement du revêtement de beton des galeries minières." (12)"Automatisation appliquée a l'industrie minerale." (13)"Simulation des reseaux de ventilation souterrains." (14)"Synthèse de l'utilisation des boulons d'ancrage dans les mines du Québec établissement d'une utilisation standard des boulons d'ancrage pouvant être appliquée."
Department of Mining Engineering Queen's University KINGSTON, Ontario Peter Scott Administrative Assistant (613) 547-5760	Queen's provided a summary report on its current R&D projects, as well as a copy of "Research in Progress -1983". These are as follows: (1) Study of in situ stress measurements at Camflo Mines, including computer modelling of stress parameter data determined underground. (2) Study of non-destructive rockbolt load capacity measurement. (3) "On-going" research in minimization of blast vibrations and optimization of rock mass fragmentation. (4) Development of a computerized open pit package, including: -Geostatistical analysis. -Pit boundary analysis. -Computer assisted mine planning. -Automated mine planning using linear programming -Haulage road location studies. -Computer assisted blast designs. (5) Development of a computer aided system for underground mine planning and design. (6) Study of properties of backfill materials for frozen backfills, in frozen environments. (7) Study of radioactive properties of ore and backfill materials in uranium mines to more accurately predict radiation levels. (8) Testing of slag pyrite for underground backfill. (9) Examination of underground haulage systems using a computer model.

ACTIVITIES MENTIONED: MINING TECHNOLOGY DEVELOPMENT INDEX,1984

PARTICIPATING ORGANIZATIONS	TECHNOLOGY DEVELOPMENT ACTIVITIES
Department of Mining Engineering Queen's University KINGSTON, Ontario (cont'd)	(10)Laboratory studies of high density tailings fill slurry viscosities. (11)Study of the structure, methods and requirements of maintenance systems in mining operations. (12)Development of the application of numerical techniques in rock mechanics. (13)Field evaluation of a vibrating overburden drill to assess operating characteristics. (14)Ventilation studies at Denison Mines to establish a computer model of the mine ventilation network.

APPENDIX B

TECHNOLOGY DEVELOPMENT CATEGORIES: MINING TECHNOLOGY DEVELOPMENT INDEX

1984

TECHNOLOGY DEVELOPMENT CATEGORIES: MINING TECHNOLOGY DEVELOPMENT INDEX, 1984

KEY TO PARTICIPATING ORGANIZATIONS

A: La Compagnie Minière Québec Cartier
B: Denison Mines Limited
C: Detour Lake Mine
D: Falconbridge Limited
E: HDRK Mining Research Limited
F: Hudson Bay Mining and Smelting Co., Ltd.
G: Inco Limited (Copper Cliff, Ontario)
H: Inco Limited (Thompson, Manitoba)
I: Johns Manville Canada Inc.
J: Mine Accident Prevention Association Ontario (MAPAO)
K: The Mining Industry Research Organization of Canada (MIROC)
L: Noranda Research Centre
M: Potash Corporation of Saskatchewan Mining Limited
N: Qit-Fer et Titane Inc.
O: Rio Algom Limited
P: Sherritt Gordon Mines Limited
Q: Sigma Mines (Québec) Limited
R: Sullivan Mine (Cominco Limited)
S: Mining Research Laboratories, CANMET, EMR
T: Centre de Recherches Minerales (Ministère de l'Energie et des Ressources)
U: Earth Sciences Sector, EMR
V: Natural Science and Engineering Council of Canada (NSERC)
W: Université Laval
X: Queen's University (Department of Mining Engineering)

KEY TO TECHNOLOGY DEVELOPMENT CATEGORIES

Drilling	Page 16
Blasting	Page 17
Mine Leaching	Page 18
Ground Control	Page 19
Materials Handling	Page 21
Backfilling	Page 22
Mine Design	Page 23
Communications	Page 24
Health and Safety	Page 25
Equipment General	Page 27
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Processing/Metallurgy	Page 29

TECHNOLOGY DEVELOPMENT CATEGORIES: MINING TECHNOLOGY DEVELOPMENT INDEX, 1984

TECHNOLOGY DEVELOPMENT CATEGORIES	TECHNOLOGY DEVELOPMENT ACTIVITIES
Drilling	(1) Testing of two drill jumbos which have been converted for up-hole drilling. (B) (2) Surveying deviations in long large diameter (6½") drill holes. (G) (3) Development of an ITH machine with component breakdown to a 24" x 24"size. (G) (4) HDRK project to automate drill rod handling. (D) (5) Plans to develop automated down-the-hole drilling. (D) (6) Plans to evaluate high pressure water drills. (D) (7) An evaluation study of a mining machine bit. (M) (8) Experimental operational testing of 4½" "up-hole" drills. (R) (9) Consideration of researching and developing a mining machine that would operate in hardrock headings dipping from +5° to +85°. (R) (10) Development of technologies, techniques and equipment for the cutting of hard rock, utilizing high pressure water jets with other relevant devices. (E) (11) Studies to improve productivity in raise boring. (E) (12) Possible future studies pertaining to continuous mining, including the use of ore sorters in conjunction with the continuous breakage of rock. (E) (13) Granulometre continu à laser. (W)

TECHNOLOGY DEVELOPMENT CATEGORIES: MINING TECHNOLOGY DEVELOPMENT INDEX, 1984

TECHNOLOGY DEVELOPMENT CATEGORIES	TECHNOLOGY DEVELOPMENT ACTIVITIES
Blasting	(1) Evaluation of smooth wall blasting techniques. (G) (2) Field testing of blasting charges. (G) (3) Blast vibration monitoring. (G) (4) Blast simulation by computer model. (G) (5) Testing of "double-decked" crater blasting. (G) (6) Evaluation of water emulsion explosives. (G) (7) Program to optimize big-hole blasting by monitoring vibration and by mine wide microseismic monitoring of ground movement. (D) (8) Continuous research involving new explosives. (R) (9) "On-going" development of technology related to the manufacture, storage, transportation and use of explosives. (S) (10) "On-going" research in minimization of blast vibrations and optimization of rockmass fragmentation. (X)

TECHNOLOGY DEVELOPMENT CATEGORIES: MINING TECHNOLOGY DEVELOPMENT INDEX, 1984

TECHNOLOGY DEVELOPMENT CATEGORIES	TECHNOLOGY DEVELOPMENT ACTIVITIES
Mine Leaching	(1) Program involving large-scale underground testing of heap leaching. (B) (2) Study of the in situ mining of copper oxide ore by leaching. (L)

TECHNOLOGY DEVELOPMENT CATEGORIES: MINING TECHNOLOGY DEVELOPMENT INDEX, 1984

TECHNOLOGY DEVELOPMENT CATEGORIES	TECHNOLOGY DEVELOPMENT ACTIVITIES
Ground Control	(1) Installation and evaluation of 20 feet stressed cable bolts in pre-sheared pit walls. (I) (2) Development of a "Spray on" coating for ground support.(G) (3) Microseismic monitoring. (G) (4) Development of a 3-D numerical modelling system for rock mechanics. (G) (5) Study of microseismic ground monitoring. (D) (6) "On-going" seismicity study encompassing surface and underground monitoring to detect mining induced earth movement. (M) (7) Consideration of the development of novel ground monitoring instrumentation to overcome deficiencies of existing instrumentation such as awkwardness, non re-usability, expense and a low success ratio. (L) (8) Development and circulation of a uniform rockburst report form designed to subject resulting data to computer analysis. (J) (9) "On-going" rock mechanics/geotechnical study at the Belmoral Mine. (T) (10) Long-term projects to increase expertise in rock mechanics. (T) (11) An "on-going" study projected to determine rock bolting needs at Les Mines Seleine Inc. (T) (12) Investigation of underground stability related to geological structure and gravitational forces and development of empirical, statistical and deterministic models to predict structural stability. (S) (13) Investigation of underground stability related to high stresses and associated rockbursts and, using instrumentation, models, mining layouts and designs to minimize failures. (S) (14) Development of new computer models for evaluating stability of underground openings and related structures. (S) (15) Evaluation of limitations and effectiveness of existing and proposed support systems for use in deep mining under high stress conditions. (S) (16) Laboratory tests on rocks and other structural materials to provide material properties data for parallel field and model studies. (S) (17) Dimensionnement des revêtements de beton des galeries souterraines. (W) (18) Prevision de l'imminence de l'effondrement du revêtement de beton des galeries minières. (W) (19) Synthese de l'utilisation des boulons d'ancrage dans les mines du Québec; etablissement d'une utilisation standard des boulons d'ancrage pouvant être appliquée. (W)

TECHNOLOGY DEVELOPMENT CATEGORIES: MINING TECHNOLOGY DEVELOPMENT INDEX, 1984

TECHNOLOGY DEVELOPMENT CATEGORIES	TECHNOLOGY DEVELOPMENT ACTIVITIES
Ground Control (cont'd)	(20) Study of in situ stress measurements at Camflo Mines, including computer modelling of stress parameter data determined underground. (X) (21) Study of non-destructive rockbolt load capacity measurement. (X) (22) Development of the application of numerical techniques in rock mechanics. (X)

TECHNOLOGY DEVELOPMENT CATEGORIES: MINING TECHNOLOGY DEVELOPMENT INDEX, 1984

TECHNOLOGY DEVELOPMENT CATEGORIES	TECHNOLOGY DEVELOPMENT ACTIVITIES
Materials Handling	(1) Continuing collaboration with Québec-Hydro and General Electric to evolve a trolley-truck haulage operation.(I) (2) Analysis of automatic skip loading. (I) (3) Evaluation of roller compacted concrete for underground roadway paving. (G) (4) Installation of a new rail haulage system. (O) (5) Study of low-profile haulage equipment. (O) (6) Provision of "on-going" technical services to the Québec mining industry on hoisting plant operations. (T) (7) Etude du soutirage des blocs mineralises aux niveaux 16 et 18 de la mine. (W) (8) Examination of underground haulage systems using a computer model. (X)

TECHNOLOGY DEVELOPMENT CATEGORIES: MINING TECHNOLOGY DEVELOPMENT INDEX, 1984

TECHNOLOGY DEVELOPMENT CATEGORIES	TECHNOLOGY DEVELOPMENT ACTIVITIES
Backfilling	(1) Backfill mining program, involving testing of open and free drainage fill fences, filter media and various types of drainage pipes. (B) (2) Investigation of nickel slag as a binding agent for fills. (G) (3) Investigation of strengths of consolidated fills. (G) (4) High density fill. (G) (5) Investigation of grouts to consolidate in situ fill materials. (G) (6) Investigation of iron ore blast furnace slag as a binding agent for fills. (G) (7) Test work underway to reduce the cement content of backfill and increase the slag content. (D) (8) Backfill project investigating underground fill transport, fill placement, drop pipes and backfill compaction. (M) (9) Study of the in situ consolidation of backfill by freezing, injections, etc. to reduce cement costs and the dilution of pillar ore. (L) (10) Review of the use of ice as a temporary fill material while mining pillars. (L) (11) Study of properties of backfill materials for frozen backfills in frozen environments. (X) (12) Testing of slag pyrite for underground backfill. (X) (13) Laboratory study of high density tailings fill slurry viscosities. (X)

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TECHNOLOGY DEVELOPMENT CATEGORIES	TECHNOLOGY DEVELOPMENT ACTIVITIES
Mine Design	(1) Development of a "timberless" undercut and fill mining method. (G) (2) Methods under study to improve ore recovery from pillars between filled stopes. (D) (3) Studies of ways to stabilize permafrost. (R) (4) Preparation of a proposal to develop a new mining method with one of the main objectives being to reduce or eliminate the cyclic elements of mining. (L) (5) Development of a CAD system for mine design, utilizing personal computers rather than costly main frame equipment. (L) (6) Dimensionnement des piliers de surface d'exploitations minières. (W) (7) Assistance a la planification d'exploitations souterraines à Mines Gaspé. (W) (8) Development of a computerized open pit package, including: - geostatistical analysis. - pit boundary analysis. - computer assisted mine planning. - automated mine planning using linear programming. - haulage road location studies. - computer assisted blast designs. (X) (9) Development of a computer aided system for underground mine planning and design. (X)

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TECHNOLOGY DEVELOPMENT CATEGORIES	TECHNOLOGY DEVELOPMENT ACTIVITIES
Communications	(1) Evaluation of communications systems, especially those with frequencies which pass through salt. (M) (2) Successful installation of an underground communications system based on leaky cable equipment. (R) (3) Phase I of an underground communications study incorporates the evaluation of systems now available for underground usage, the evaluation of the suitability of such system components for use in an underground environment, the evaluation of underground communication needs, as well as the determination of costs. (T) (4) Phase II of the underground communications study, now being formulated, is designed to determine the best systems for particular underground needs. (T) (5) Development, and ultimately field testing, of a new concept for underground radio communication. (K)

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TECHNOLOGY DEVELOPMENT CATEGORIES	TECHNOLOGY DEVELOPMENT ACTIVITIES
Health and Safety	(1) Introduction of a safety system. (O) (2) Continuing research into fire resistant hydraulic fluids. (R) (3) Continuing research into the control of diesel emissions. (R) (4) Investigation of ways to try to improve miners' personal working gear, pertaining to hearing, respiratory protection, various items of clothing and lighting equipment. (K) (5) Development of a miner's air-flow helmet, featuring dust protection and incorporating a new lamp. (K) (6) Development and testing of a 12-volt mini halogen cap lamp, designed to result in lower cost per man-day, for a better light and less maintenance. (K) (7) Development of a miner's worksuit with a comfortable water-resistant fabric. (K) (8) Development of a lighter and more protective workboot than previously available. (K) (9) Development of a system for monitoring mine ventilation. (K) (10) Maintenance of a ventilation advisory service to Ontario mines. (J) (11) Introduction of a uniform accident investigation form for Ontario mines in order to subject assembled data to computer analysis. (J) (12) Evaluation of environmental contaminant and ventilation parameter sensors and systems for underground environmental assessments. (S) (13) Development of an optimal air quality index, in conjunction with field trials of diesel emission reduction strategies. (S) (14) Development and testing of radiation instrumentation for measurement and control of radiation. (S) (15) Measurement of the current levels of respirable dust in selected Canadian mines, as well as identification and assessment of dust control measures. (S) (16) Quantification and documentation of the major sources of vibration in hardrock mines, combined with development of indicated instrumentation. (S) (17) Ventilation miniere: impact des normes sante au travail. (W) (18) Implementing a monitoring system for the ventilation network at Brunswick Mining and Smelting Corporation Limited. (W) (19) Evaluation quantitative informatisee de la ventilation miniere. (W)

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TECHNOLOGY DEVELOPMENT CATEGORIES	TECHNOLOGY DEVELOPMENT ACTIVITIES
Health and Safety (cont'd)	(20) Influence de la prime rendement sur les accidents du travail dans les mines souterraines du Québec. (W) (21) Simulation des reseaux de ventilation souterraines. (W) (22) Study of radioactive properties of ore and backfill materials in uranium mines to more accurately predict radiation levels. (X) (23) Ventilation studies at Denison mines to establish a computer model of the mine ventilation network. (X)

TECHNOLOGY DEVELOPMENT CATEGORIES: MINING TECHNOLOGY DEVELOPMENT INDEX, 1984

TECHNOLOGY DEVELOPMENT CATEGORIES	TECHNOLOGY DEVELOPMENT ACTIVITIES
Equipment General	(1) Continuing search and evaluation of low profile mining equipment. (B) (2) An "on-going" review of equipment strengths and weaknesses. (D) (3) Field tests of a device for on-board monitoring of K-40, for a projected machine mounted ore analyser. (M) (4) Studies pertaining to the sonar guidance of mining machines. (M) (5) A study of energy economics, including the use of heat exchangers, as well as the cleaning and reuse of hydraulic and lubricating oil. (T) (6) Participation in the preparation of national safety standards pertaining to equipment operation in underground mines, while conducting research in the fields of gas and dust explosions and fire resistance. (S) (7) Promotion of mining equipment developments for mine development, production and transportation, as well as assessment of the impact of such equipment on mine design, including associated automation, remote control or robotics. (S) (8) Studies devoted to the development of techniques for reducing the noise levels of diamond drilling equipment. (S) (9) Study of the structure, methods and requirements of maintenance systems in mining operations. (X) (10) Field evaluation of a vibrating overburden drill to assess operating characteristics. (X)

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TECHNOLOGY DEVELOPMENT CATEGORIES	TECHNOLOGY DEVELOPMENT ACTIVITIES
Miscellaneous-Mining	(1) Development of computerized warehousing and maintenance systems. (O) (2) Consideration of underground computer terminals for shift boss reporting. (R) (3) Preparation for field testing of an ultra sonic survey probe for determining the contours of inaccessible open stopes. (L) (4) Consideration of the development and testing of a new concept for air-powered space lighting underground. (K) (5) A mine lighting study to recommend types and spacing of lights for various underground situations. (J) (6) Long-term projects to develop computer software for mine usage. (T) (7) By means of research contracts, studies are being conducted encompassing a survey of mine needs for computing devices and software, mine ventilation, simulation and optimization, as well as relationships between bonus, productivity, profitability and security. (T) (8) Development of a mining cost computer data base, cost models and mine evaluation procedures. (S) (9) Development of technology and methods for the management of mine/mill waste to reduce environmental impact. (S) (10) Contract research for Canadian potash mining pertaining to ground control, environment and productivity. (S) (11) Recherche en fluorescence. (W) (12) Automisation appliquee a l'industrie minerale. (W)

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TECHNOLOGY DEVELOPMENT CATEGORIES	TECHNOLOGY DEVELOPMENT ACTIVITIES
Processing/Metallurgy	(1) An "on-going" project searching for suitable smelter feedstocks. (N) (2) A large sintering study being conducted in Belgium and USA. (A) (3) Elimination of discolouration in liquid mill effluents.(A) (4) Computerized system to improve concentrate feed blending. (developed at McMaster). (A) (5) Means of relating drill hole cuttings from each ore block to ore reactions in the mill, to improve the predictability of concentrate grades. (A) (6) Improvement of recovery of iron fines now lost in tailings. (A) (7) Development of an on-stream analyser for instantaneous reaction to changes in milling conditions. (A) (8) Elimination of a moisture migration problem in concentrates. (A) (9) Evaluation of the economics of gas or electric drying as a replacement for bunker "C". (I) (10) Development of automation and remote control equipment for possible use in the milling operation. (I) (11) Project concentrating on improvement of refinery operation by reducing impurities poured into (gold) bricks. (Q) (12) Design of a continuous fluxing process. (F) (13) Development of a mechanical stacker in the zinc plant. (F) (14) Examination of a two-stage pressure leach. (F)

TECHNOLOGY DEVELOPMENT CATEGORIES: MINING TECHNOLOGY DEVELOPMENT INDEX, 1984

SUMMARY OF TECHNOLOGY DEVELOPMENT CATEGORIES	NO. ORGANIZATIONS INVOLVED	NO. PROJECT ACTIVITIES REPORTED
Drilling	7	13
Blasting	5	10
Mine Leaching	2	2
Ground Control	10	21
Materials Handling	6	8
Backfilling	6	13
Mine Design	7	11
Communications	6	7
Health & Safety	6	22
Equipment General	6	10
Miscellaneous-Mining	8	11
Processing/Metallurgy	5	14
Total		142

OPINION POLL

CANMET is interested in your evaluation of this Technology Development Index, as well as your suggestions for improvement.

Some aspects on which your comments would be appreciated are the following:

- Is this projected service worthwhile for your purposes?
- Would you suggest modifications?
- Are there omissions in the proposed format?
- Would you like to be contacted for inclusion in the survey?

Comments

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POOR

QUALITY

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